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UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

FUEL TYPE MAPPING

REGION TWO

1938

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ROCKY MTN. FOREST & RANGE
EXPERIMENT STATION

K
Plans
Presuppression
Fuel Types

Denver, March 8, 1938.

FOREST SERVICE
ROCKY MOUNTAIN FOREST & RANGE EXP. STATION
FORT COLLINS, COLORADO
MAR 9 - 1938
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Forest Supervisors:

There are attached sufficient copies of our Regional "Instructions for Fuel Type Mapping" to provide a copy for your office and for each of your Rangers.

The purpose of these instructions and illustrations of ratings is to provide a common visual basis for the fuel rating work which it is planned to complete throughout the Region before 1940. Leadership in organizing this work will be assumed by this office, but the soundness of the ratings will depend to a considerable degree on contributions that can only be made by field men thoroughly familiar with local forest conditions.

Fuel rating work on the following Forests is planned for this summer:

Bighorn
Cochetopa
Grand Mesa
Montezuma
Rio Grande
Roosevelt
San Juan
Shoshone
Washakie

You will be notified in advance of the arrival of fuel type mappers on your Forest, and it is expected that each member of your force will contribute as much as he can to the work. The ratings are subject to careful review in your office before being used as the basis for your Forest plans. Any disagreement as to their basis or correctness may be taken up directly with Mr. A. A. Brown when he visits your Forest and who will be responsible for coordinating the work.

Extra copies of these instructions are available on request.

M. N. THOMPSON

Enclosures

Assistant Regional Forester

F
Plans
Presuppression
Fuel Types

Denver, Colorado.
January 28, 1938.

INSTRUCTIONS FOR FUEL TYPE MAPPING
ROCKY MOUNTAIN REGION

The following instructions have been developed for general use throughout the Region, but may be further supplemented as the need occurs for additional fuel type descriptions or for better illustration by key photograph of typical forest fuel combinations. They are designed both to guide the judgment of the fuel type mapper in the field and to provide a common basis for discrimination on the part of Forest and Regional Office personnel in setting up fire control plans and in determining correct Regional policies.

To insure uniformity in these fuel type ratings with the similar work being done in adjoining Regions, the following general instructions apply:

Basis for Classification

Two factors will be used as the primary basis for classification. The first is the probable rate of spread of fire in the fuel being considered, the second is the relative difficulty of control or "resistance to control" of fire represented by that fuel in place. The first can be measured and defined as the rate at which a fire will increase its perimeter in a definite period of time from its start; the second as the relative amount of work in man hours required per unit of this perimeter to control the fire. Both can be converted to a common basis, and their variations expressed in terms of the job to be accomplished. "Rate of spread" is the key to the length of control line in chains that will have to be worked after the fire has spread for a given time; "resistance to control", measures the amount of work needed to produce and hold one chain of this control line. Together, they measure the size and difficulty of the job to be done. Neither can be precisely determined in advance for a single fire, but since both are definite and measurable after it occurs, the results and correctness of the rating work can be tested by current experience and past history. For planning purposes, definite values have been assigned to both. Values used for the rates of spread are 4, 8, 12, and 18 chains of perimeter increase per hour. Values for the degrees of resistance to control are 3.2, 1.6, 0.8, and 0.2 chains of held line per man hour. Both will need some further check throughout the Region before they are finally fixed.

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The rating of both factors as they vary from place to place in the field must be accomplished by exercise of the judgment. Accordingly, relative rather than numerical terms are used. Rate of spread is classified by degree into four descriptive ratings as follows:

Extreme
High
Medium
Low

The degree of resistance to control is rated by these same four terms. In use, each is abbreviated to the first letter of the word, thus: E., H., M., L. For any particular fuel, a reasonably good definition of the fire problem it represents, can be pictured by the joint rating of these factors. Thus, grass areas may carry an H. L. rating, representing a high rate of spread but little work per chain of control line; consequently, a low resistance to control rating. Extreme ratings have but little application in this Region, since they represent fuels seldom encountered over any significant area. However, the three ratings only, give us nine possible combinations or classes of fuel which can be distinguished. In addition, the danger of quick development of a crown fire is distinguished by adding a "C" numerator to the dual rating to further define the particular problem represented by the fuel, thus: C/HH. This particular factor is further discussed under the caption "Danger of Crown Fires".

On setting up the rating symbols the rate of spread is always represented by the first letter, the resistance to control by the second.

Timber Types

Timber types, in so far as they represent a particular combination of fuels, have significance in this classification. Unfortunately, each major vegetative type varies a great deal locally in the fire problem it represents, due to variations in age, density, condition, topography, etc. This is the chief justification for rating fuels independently. But there is a tendency for certain typical fuel combinations in ponderosa pine to take an M. M. rating for example, and for certain similar combinations in lodgepole to take an L. M. rating. Accordingly, if both the fuel type rating and the vegetative type are known, a much better mental picture of the fuel condition is obtained, and we have a sounder basis on which to build fire control plans. For this reason, the program contemplates starting with the most accurate vegetative cover type data available and taking advantage of the major vegetative type boundaries located on the map. The fuel type classification can then proceed largely

as a matter of subdivision within these major type boundaries. Timber survey and grazing survey maps will be the most useful for this purpose.

Scale of Map

For field use, the minimum scale that will permit satisfactory work is 1" to the mile. In many cases 1/2" scale may be used for the final compilation for plan use, but it will be preferable to later copy the data to reduced scale rather than to attempt to enter field data directly on the smaller scale.

Burning Conditions

To assure sound fuel ratings it is necessary to visualize a fixed burning condition, then to picture what would happen in the spot being rated if a fire should start there. That is, how fast would the fire run and how hard would it be to stop it? The fuel ratings must be a satisfactory answer to both these two questions. Naturally, answers depend on the burning condition assumed. The standard condition assumed for rating purposes is that of the worst burning condition to be expected in the average year. In the five ratings of fire danger used for the Region 2 "danger meter" which are described in similar terms to the fuel ratings as- Extreme, High, Moderate, Low and Dormant or as danger classes 5, 4, 3 and 2 and 1, respectively, this burning condition is normally represented by the division point between the Moderate and High danger classes. Usually this will mean a hot dry day in August with humidity of 20% and a five to ten mile wind, or in areas where grass and annual vegetation comprise the critical fuel, it may represent dry but cooler conditions later in the season after such vegetation is dry enough to carry fire. Extreme conditions of drought will create much worse conditions at times, while favorable weather conditions and green vegetation will make the problem much easier during most of the fire season. Current fluctuations above and below this "average worst" condition will be determined through current check of burning conditions as reflected by the records of fire danger stations. The final plan of fire preparedness will be designed to meet these fluctuations as they occur.

Factors in Forest Fuel Type Ratings

Several factors must be combined to determine the ratings to be assigned. Besides the fuel itself, the degree of slope has a very marked influence on the rate of spread. In many cases with identical fuels, the rate of spread will vary from low in the flats to moderate or high on slopes of 50% or more. Resistance to control is not greatly influenced by degree of slope alone until slopes become so steep that they interfere with movement of crews and cupped trench becomes necessary to hold rolling debris. This may hold up the rate of line construction and then needs to be included.

Exposure to sun and wind is almost equally important to slope in determining the probable rate of spread. On the west side of a mountain the chances are often eight out of ten that any fire starting at the foot will have a west wind behind it to speed its run up slope, so that for slopes of 30% or more a distinction between east and west exposures of one step in rate of spread ratings is usually justified. Due to greater exposure to the sun, south slopes will be associated with the west exposures, and the damper north slopes will be associated with the east exposures on the same basis. It will not be possible to distinguish short slopes of all minor drainages. The minimum areas to be mapped will control. In addition to general direction of exposure, as determined by topography, the existence of a protective timber canopy, or of wind breaks, needs to be recognized locally in determining ratings. Often such local factors are most important of all, and are recognized in many of the following fuel descriptions:

Specific forest fuel combinations will be discussed in describing each key fuel rating. However, several generalizations may be drawn as a background to these ratings. The volume of fuel on the ground will determine the amount of heat generated by a fire. This usually affects the difficulty of control more than it does rate of spread. Usually the more fuel present, the more work there is in removing it from in front of the fire and the more difficult it is to work close to the fire. In addition, large volumes of fuel increase the danger of spotting and of crowning. To a mapper experienced in fire fighting, the resistance to control rating should be the answer to the question of how much work will be required to build and hold fire line in case a fire starts here. Heavy fuels such as logs and heavy debris often necessitate a great deal of chopping and bucking but do not produce heat as fast as finer fuels such as slash. Loose slash and other fine materials are easier to remove, but in quantity produce so much heat that direct attack in cooling down or in removing fuel directly from their path becomes difficult. Accordingly, heavy volumes alone which will produce intense heat, can justify high resistance to control ratings in the absence of frequent natural breaks. In general, however, abundant heavy fuels will give high resistance to control ratings, and low or moderate rates of spread, while continuous fine fuels will give high rates of spread with lower resistance to control ratings.

Snags constitute an additional important factor. Where punky or with loose bark or shaggy dead limbs, they become a source of great difficulty in controlling a fire, due to their tendency to catch on fire in the top and to throw sparks across the fire line. As a result, they have to be cut, to insure control and increase the difficulty of control. Where clean and sound they are less troublesome and may largely be disregarded.

Danger of Crown Fires

The danger of a fire getting into the crown canopy and of spreading as a crown fire in the full sweep of the wind, is in many types the most critical factor of all. The danger of crowning may be judged by examining the degree to which fuels are represented at successive levels--at the ground surface, in the understory, and in the crowns. Any dense and continuous crown canopy in conifers will support a running crown fire under certain circumstances. We are concerned, however, with the liability of a crown fire developing in place from a small fire. This depends not only on the crown canopy but on the fuels beneath which can produce enough heat to ignite the crowns. This can occur either through the presence of an inflammable understory, which carries flame by steps directly to the crowns or through the presence of a surface fuel capable of producing a quick intense heat sufficient to bridge the gap between the ground surface and the crown canopy.

Such conditions are found quite commonly in the dense ponderosa pine reproduction and pole stands typical of much of the Black Hills territory. Extensive thinning operations in such stands have reduced or eliminated the crowning hazard, but wherever the slash has been left, the result is a flashy and very hot ground fuel often fully exposed to sun and wind creating a critical HH rating on slopes. As the crowns gradually close again and the slash decays the rating will eventually be reduced much below that of the original overstocked stand. While the high inflammability still exists, there is however, an advantage in the fact that a going fire in the thinning slash can be fought successfully on the ground provided large crews can be mobilized quickly, as compared to the problem of a running crown fire. Such distinctions have been carefully studied and are reflected in the fuel ratings described, largely through the presence or absence of the "C" rating as a numerator to the other two symbols.

The liability of a crown fire in the lodgepole type is, in general, limited to dense reproduction with crowns not more than five feet clear of the ground, with intermingled hot surface fuels partially exposed to sun and wind in openings or on the fringes, to uneven aged stands with high slash fuel hazard, and to pole stands on steep slopes where considerable surface fuel exists. This is on the basis of rating fuel at the point of ignition. Under extreme conditions, the momentum of a large fire once it is under way, with a brisk wind, will carry it as a crown fire through almost any lodgepole stand until a change in burning conditions occurs.

The Douglas fir type in northern Wyoming presents high crowning hazard wherever dense stagnated stands occur on steep dry slopes. The presence of a great volume of persistent dead limbs, of dry surface fuel and of tree moss are the chief factors contributing to such a rating and are reflected in the fuel descriptions for this type.

Spruce stands typically represent a nearly universal crowning hazard under extreme conditions, but due to the usual moist protected site, the danger of crowning from ground fuels in place is normally least critical of all. The potentialities of fire in spruce as reflected by the great and destructive conflagrations of the past in Colorado need to be recognized and the fuel mapper's attention is called to them through recognition of even delayed crowning hazard in this type, wherever exposed slash or other hot fuel is intermingled with or adjacent to continuous spruce stands with uneven crown canopy.

An additional factor in creating a crown fire hazard is the presence of tree moss in the crown canopy. This is rare in the Central Rocky Mountain Region, but has been found in considerable amount in certain areas on the Shoshone. Such moss usually justifies a higher rate of spread rating and needs to be further identified by showing the crown fire liability.

In several ways the danger of crowning in the various types discussed above is not adequately covered by the dual rating of rate of spread and resistance to control alone as they are applied on the ground. Due to the fact that a continuous timber cover reduces the effect of a fifteen mile wind, to that of a 2 to 5 mile wind within the stand the rate of spread changes markedly when fire gets into the crowns and is then exposed to the full fifteen mile force. The resistance to control factor also becomes unsatisfactory under such conditions as a measure of "held" line. Rather, it must be used to determine the man power needed to corral the fire after the crowning has stopped rather than during its progress.

Accordingly, wherever in the judgment of the local mapper and in the light of local experience, under "average worst conditions," crowning may result in place within one hour of start in ponderosa pine or Douglas fir, within two hours of start in lodgepole pine or within four hours of start in spruce; an additional factor will be incorporated in the rating as a numerator, thus: C/HH. The resistance to control rating will, in other words, be based on fighting the fire on the ground, and additional conflagration threats will be separately identified.

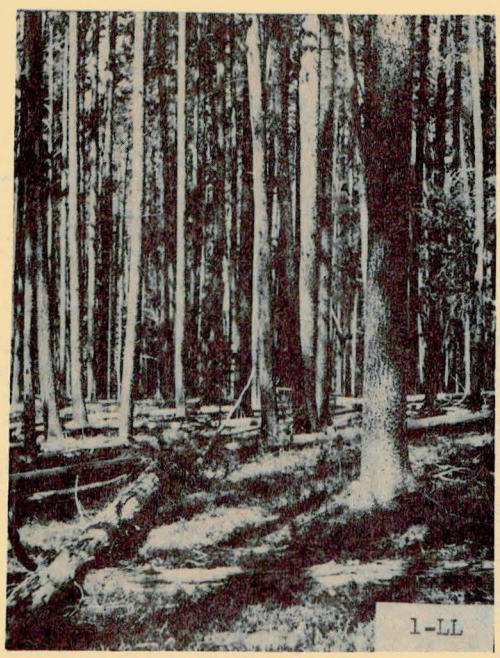
Fuel Type Specifications by Major Cover Types

The following general specifications cannot substitute for judgment exercised on the ground, and cannot cover all the fuel combinations that will be found, but are set up to aid the mapper by describing and rating characteristic combinations throughout the range just as they have been found in the field. No specific fuel type descriptions are set up for various mixed conifer timber types that occur. There should be no difficulty, however, in determining proper fuel ratings by reference to similar fuel conditions in related types. The symbols 2, 2a, 2b,

etc., will be used on the map to indicate the corresponding cover type and condition on the ground, in addition to the symbols used to indicate rate of spread and resistance to control, thus: 2b M.M. Where more than one timber type condition is represented, the description can be made more complete by following the symbol for the principal species or combination by others. A lodgepole-spruce stand of young growth for example might be indicated as 1b-2b, L.M.. Additional characteristic fuel combinations will be described and added to the list as needed in carrying on the work.

The photographs accompanying the fuel descriptions are introduced to give a better basis for visual comparisons. In most cases one condition only is illustrated for each timber type subdivision. The particular fuel description illustrated is in each case indicated by the degree symbol - °, and the fuel rating is repeated directly on the photograph. Where two photographs occur on the same page the description illustrated by the first is starred once by the symbol and the second one twice.

LODGEPOLE
Mature
Type Symbol - 1



Forest type: Over-mature, mature, or older pole stands of lodgepole.

Fuel: Small huckleberry, thin needle layer, little dead material; old logs scattered.

Location: Any - - - - - - - - - - - - - - - - LL°

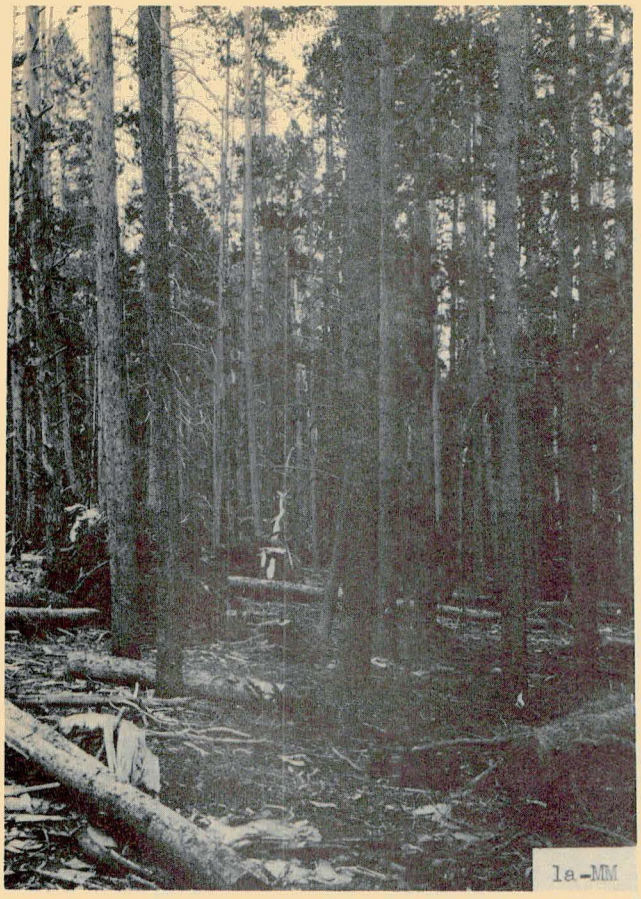
Forest Type: Lodgepole cut over (Heavy cutting areas).

Fuel: Almost continuous new slash 3' or more in depth; cull logs criss-crossed to form jack-strawed piles with much material not in contact with ground; or many wind-thrown trees, upturned roots with grass and other fine fuels well intermingled; less than 20% of canopy remaining.
Location: N and E slopes over 20% or S and W slopes over 10% - - EH
Location: Flats or N and E slopes under 20% - - - - - - - - - - - HH°

Fuel: Same as above but not continuous, heavier canopy
Location: Flats or gentle, protected slopes - - - - - - - - - - - MH

Fuel: Continuous old slash with needles gone, otherwise similar to above description for HH
Location: Steep and exposed slopes - - - - - - - - - - - - - - - - - MH
Location: Flats and protected - - - - - - - - - - - - - - - - - - - MM

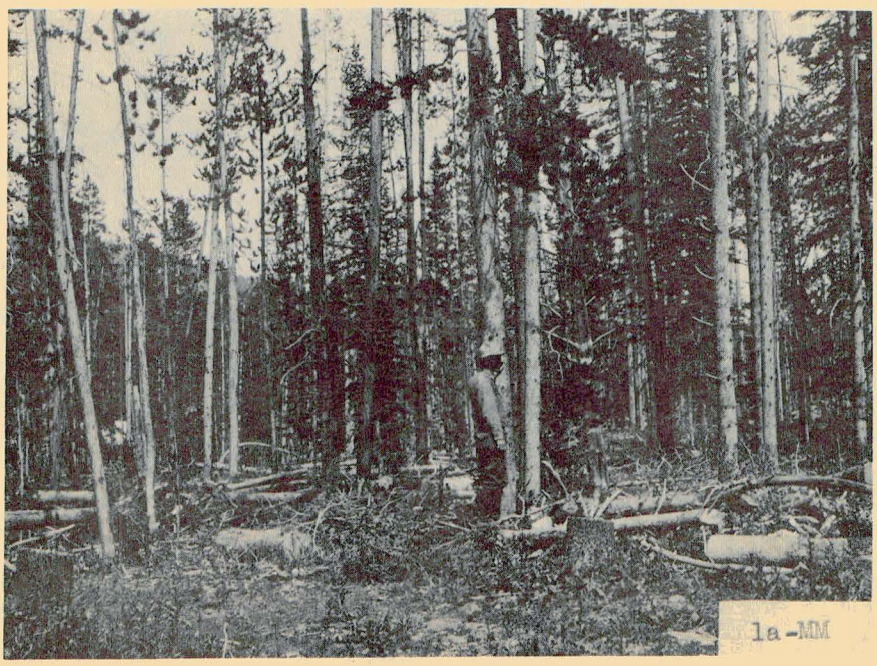
LODGEPOLE
Cut-over
Type Symbol - 1a



Forest Type: Lodgepole cut-over (selection cuttings)

Fuel: Unburned slash piles or debris less than 3' deep with clean breaks not more than 100' apart.
Location: Steep, exposed slopes - - - - HM
Location: Flats, or gentle protected slopes MM°

Fuel: Old slash with needles and fine twigs gone but continuous litter of poles and logs; some log piles; scattered fine fuels. Open canopy. Huckleberry replaced by debris and annuals.
Location: Except on very steep or exposed slopes - - - - - - - - - - MM°°



LODGEPOLE
Cut-over
Type Symbol - 1a

Forest Type: Lodgepole cut-over

Fuels: Very old slash or burned debris partially decayed, scattered; considerable fine fuels such as grass and weeds.
Location: Steep, exposed slopes - - - - - - - - - - - - - - - - - - ML

Fuels: Old slash or heavy burn debris partially decayed. Little or no fine fuels, huckleberry or bare spots making up 20% or more of area.
Location: Gentle, protected slopes - - - - - - - - - - - - - - - - LM

Fuels: Huckleberry cover re-established. Scattered logs clean of bark or branches, thin needle layer.
Location: Any - LL°

LODGEPOLE
Reproduction
unthinned

Type Symbol - 1b

Forest Type: Lodgepole reproduction - unthinned.

Fuels: Young growth with closed crown canopy, heavy debris of poles and logs. Where frequent openings are interspersed exposing the dead material and grass and other fine fuels present, stems cleaned for distance of less than 6' above ground.

Location: On steep, exposed slopes - - - - - - - - - - - - - - - - C/HH

Location: Protected - C/MH

Fuels: Dense stagnated stands forming unbroken canopy. Thin needle cover and little debris on ground. Lack of inflammable material on lower margins.

Location: Steep and exposed slopes - - - - - - - - - - - - - - C/MH

Location: Flats and protected slopes - - - - - - - - - - - - - MH

Fuels: Canopy clear of ground for more than 6'. Thin needle cover scattered clean logs and poles. No particular threat at margin or on lower slopes.

Location: Steep and exposed slopes - - - - - - - - - - - - - - LM

Location: Flats and protected slopes - - - - - - - - - - - - - LL°

LODGEPOLE

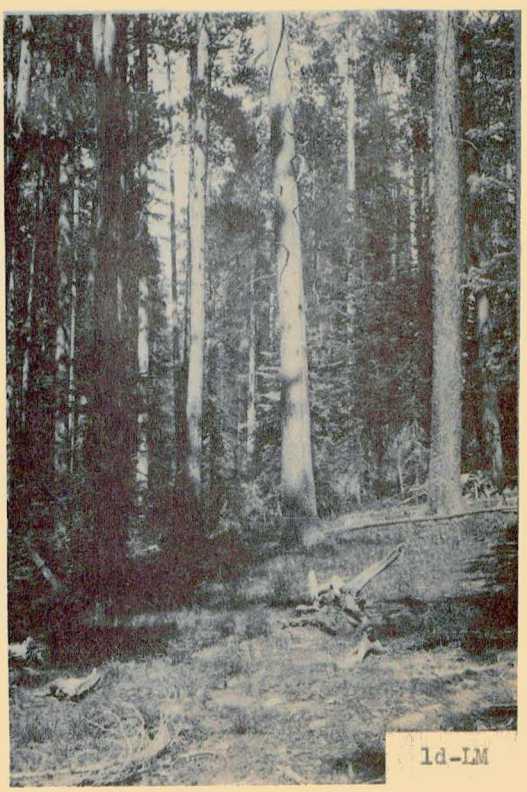
Uneven - aged.
Type Symbol - ld

Forest Type: Uneven - aged lodgepole with mixed fir and spruce

Fuels: Fine fuels such as annuals and branch wood from wind-falls, etc., considerable low reproduction with spruce and fir mixed in.
Location: Steep & exposed slopes - - - - - - C/HM

Location: Flats, or gentle protected slopes MM°

Fuels: Little fine fuel except reproduction. Few young crowns reaching into over-story. Mature trees with clean poles.
Location: Any - - - - - - - LM°



SPRUCE
Mature

Type Symbol - 2

Forest Type: Mature spruce

Fuels: Deep duff, moss, heavy litter of small limbs, considerable debris, some recent windfalls. Canopy ragged, with some snags and bug-killed trees. Tree moss on boles and lower limbs.
Location: Steep and exposed slopes - - - - - - - - - - - - - - - C/MM

Location: Steep, protected slopes. Dead limbs to ground, no tree moss - C/LH

Fuels: Same as above but with 20% or more bug-killed, many exposed openings.
Location: Steep slopes - MH

Fuels: Heavy litter, some large down logs. See illustration. Canopy closed, no litter or tree moss.
Location: Flats or gentle protected slopes - - - - - - - - - LM°

Fuels: Light, scattered litter, fewer logs. Canopy closed, boles clean.
Location: Flats or gentle, protected slope - - - - - - - - - LL

SPRUCE
Cut-over
Type Symbol-2a

Forest Type: Spruce - cut-over

Fuels: Heavy, nearly continuous undecayed slash with only narrow breaks, many wind-falls, not enough aspen to affect inflammability. Less than 20% of canopy remaining.

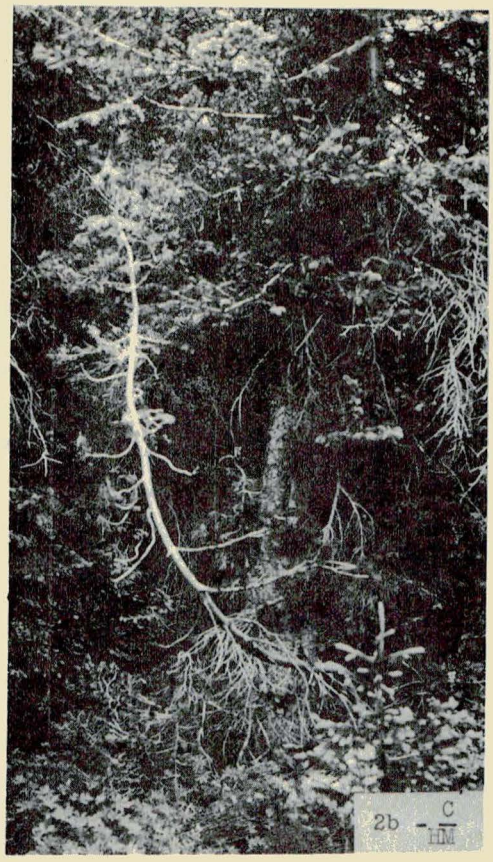
Location: Steep slopes - HH
Location: Flats or gentle protected slopes - - - - - - - - - MH°
Location: Wet flats or very well protected slopes - - - - - LH

Fuels: Same as above but with wide, frequent breaks. More than 20% of canopy remaining or with considerable aspen present.

Location: Ratings same as above but with M resistance to control.

SPRUCE
Reproduction

Type Symbol - 2b



Forest Type: Spruce and fir reproduction.

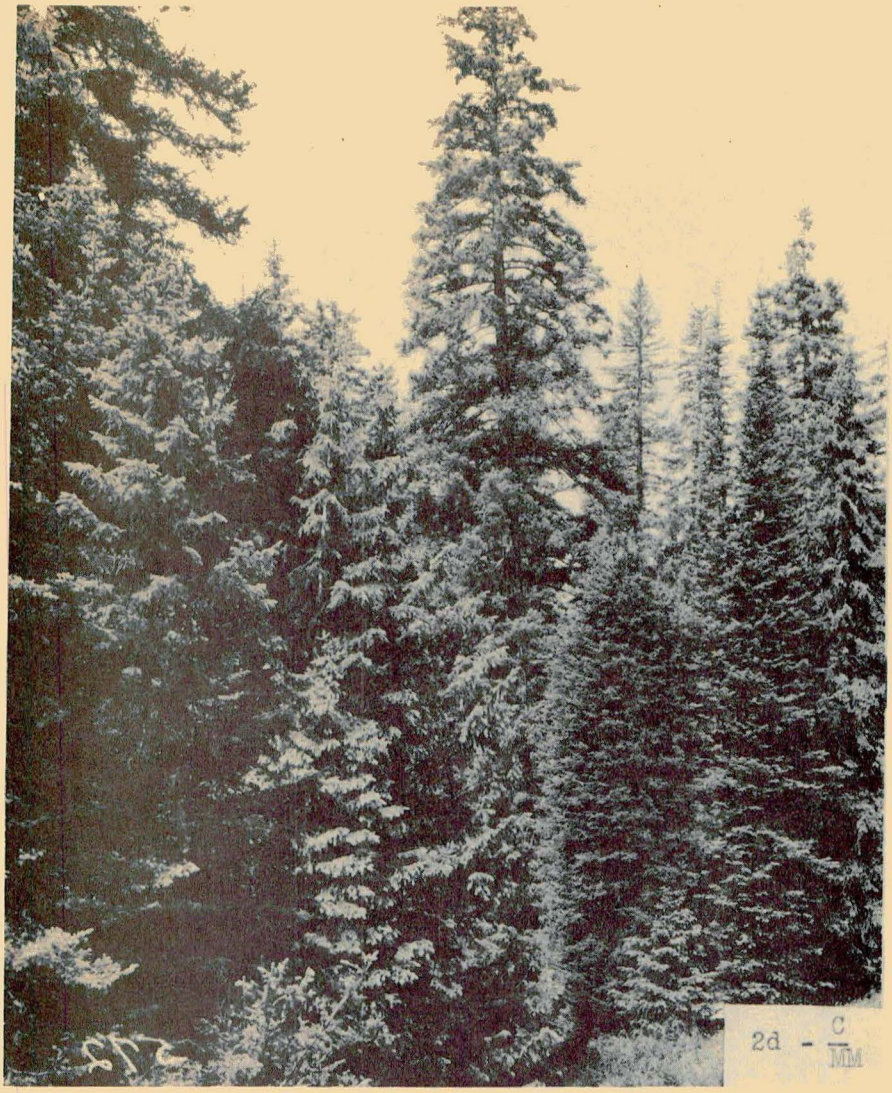
Fuels: Dense continuous stand. Little heavy fuel. Few openings or breaks. No over-story.
Location: Steep or exposed - - - - - - - - - - - - - - - - - - C/MH

Fuels: Reproduction in dense patches but separated by openings with grass and debris. Little heavy fuel.
Location: Steep or exposed slopes - - - - - - - - - - - - - - C/HM°
Location: Flats or gentle protected slopes - - - - - - - - - C/MM

Fuel: Same but with considerable overhead canopy, few exposed openings.
Location: Flats or gentle protected slopes - - - - - - - - - LM

SPRUCE
Uneven-aged

Type - Symbol - 2d



Forest Type: Uneven-aged spruce stands.

Fuels: Few snags, little debris. Canopy ragged with branches from ground up. Grassy, exposed openings.

Location: Steep or unprotected sites - - - - - - - - - - - - - C/HM

Fuels: Heavy understory of dense fir and spruce reproduction. Closed canopy.

Location: On steep and exposed slopes - - - - - - - - - - - - C/MM

Location: On flats and gentle slopes - - - - - - - - - - - - C/LM

Fuels: Young reproduction not reaching into canopy. Few openings, little dead fuel, no tree moss.

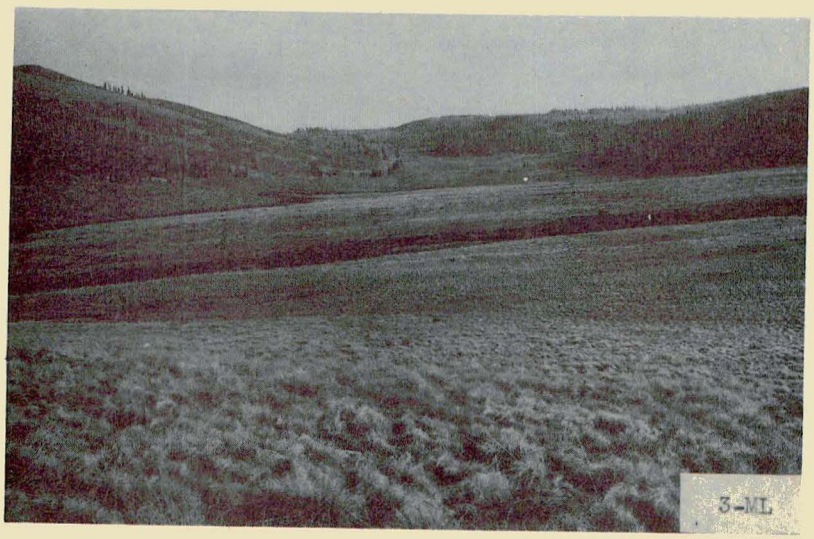
Location: Any - LM

GRASS

Type Symbol - 3

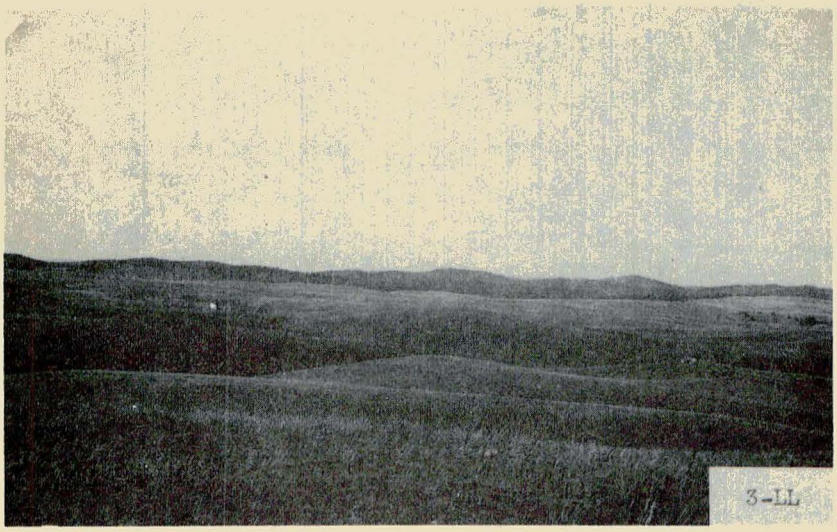
Fuel: Dense grass, ungrazed, dry for part of fire season.
Location: Any exposed slope - - - - - - - - - - - - - - - - - - HL°

Fuel: Grass less dense, partially grazed or sparse enough to allow exposed mineral soil between clumps.
Location: Any exposed slope - - - - - - - - - - - - - - - - - - ML°°

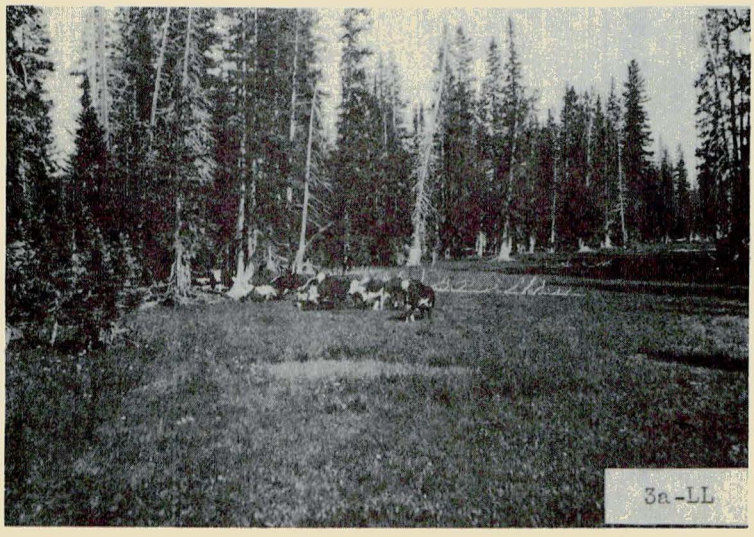


GRASS

Type Symbol - 3



Fuel: Grass, heavily overgrazed or very sparse with considerable mineral soil exposed.
Location: Any - LL°



GRASS

Wet meadow often with willow or brush

Type Symbol - 3a

Fuel: Sedges, grass that is green most of fire season, willow, some aspen or other brush. Wet most of year.
Location: Any - LL°°

PONDEROSA

Mature

Type Symbol - 4

Forest Type: Mature ponderosa pine in park-like stands.

Fuel: Continuous cover of grass, reproduction, prostrate juniper or oak. Ungrazed.
Location: Steep or unprotected slopes over 10% - - - - - - - - - - HL
Location: Flats or gentle slopes - - - - - - - - - - - - - - - - - ML°

Fuels: Heavily grazed, sparse grass and annuals, little or no reproduction, considerable exposed mineral soil.
Location: Any - LL°°

PONDEROSA

Cut-over

Type Symbol - 4a

Forest Type: Ponderosa pine cut-over

Fuels: 20% or more of ground covered by slash.
Location: Steep and exposed slopes - - - - - - - - - - - - - HH°
(If continuous and fully exposed - - - - - - - - EH)
Location: Where either piled or lopped slash with dry needles is intermingled with heavy understory of reproduction, the crowning factor "C" should be added, giving in exposed locations the highest rating to be found in the Black Hills - - - - - $\frac{C}{EH}$

Fuels: Less than 20% of area covered by slash, pretty well shaded, no grass in openings.
Location: Flats or gentle protected slopes - - - - - - - - MM

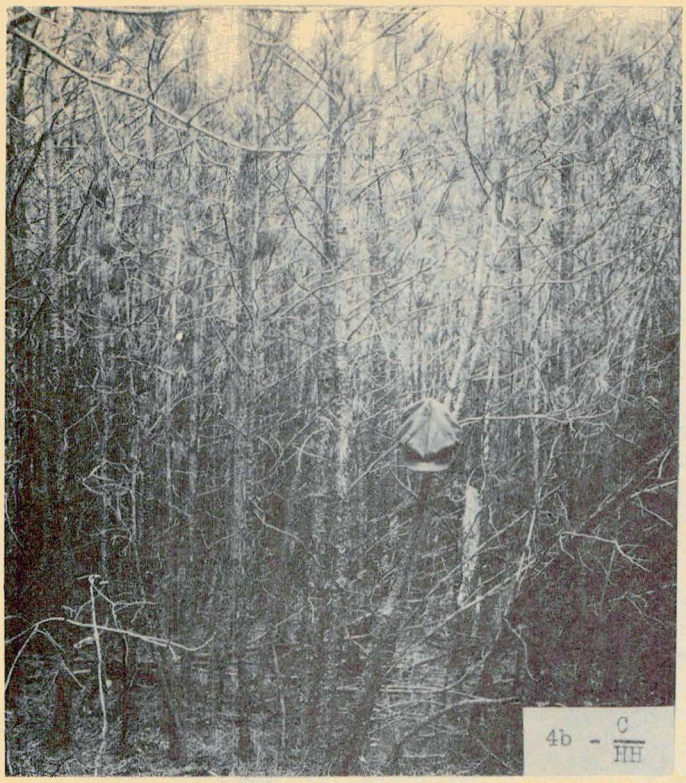
Fuels: Slash all cleaned up; some grass in openings.

Location: Any - - ML

Fuels: Same but no grass.
Location: Any - -LL°°

PONDEROSA

Reproduction
Unthinned
Type Symbol - 4b



Forest Type: Ponderosa reproduction unthinned.

Fuel: Dense, over-stocked young growth, usually under 80 years. Many dead and dying branches and stems. Heavy litter on ground. Grassy openings.
Location: Steep, exposed slopes - - - C/HH

Location: Flats or protected slopes - - C/MH

Fuels: Same as above but 10-20% aspen.
Crowning hazard absent except on very steep slopes - - - - - - - - - - - - MM

Fuels: Same but with over 20% aspen - LL°°
(See type 5a)

Fuels: Reproduction spotty or scattered, little or no debris.
Location: Any - Ratings will depend on density and type of grass or annual cover. See illustration below.

PONDEROSA

Reproduction or
pole stand
Thinned

Type Symbol - 4c

Forest Type: Ponderosa pole or reproduction stand; thinned

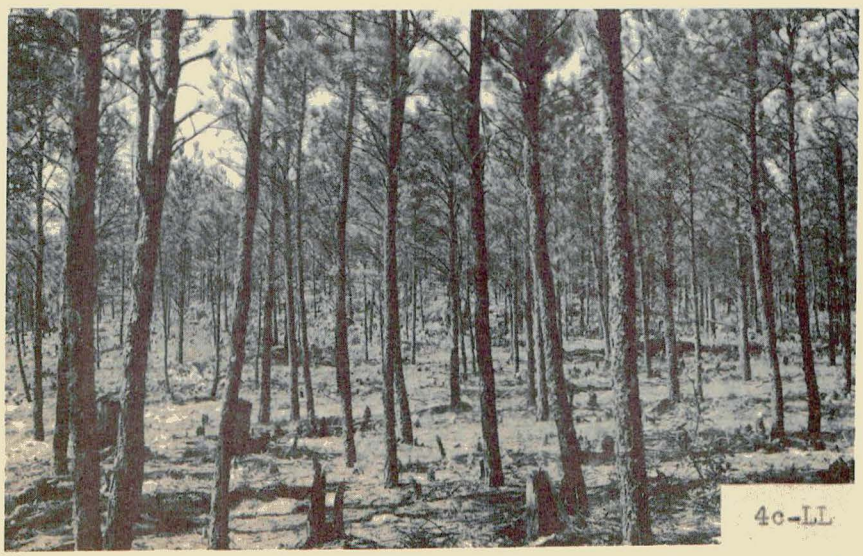
Fuels: Deep thinning slash, continuous.
Location: Steep exposed slopes - - - - - HH°
Location: Gentle or flats, more shade - - - - - MH

Fuels: Deep slash, but broken by lanes 10' and less than 100' apart.
Location: Steep, exposed slopes - HM

Fuels: Same as above but well shaded, needles gone.
Location: Gentle and protected slopes - - - - - - - - - - - - - - - - - - MM

Fuel: Slash all cleaned up, few twigs, light litter, grass coming in.
Location: Any - ML

Fuel: Same but without appreciable amount of grass.
Location: Any: - LL°°



PONDEROSA

Uneven-aged

Type Symbol - 4d

Forest type: Uneven - aged ponderosa pine.

Fuel: No slash. Openings with ungrazed grass; cover, light litter, reproduction clumpy, not continuous.

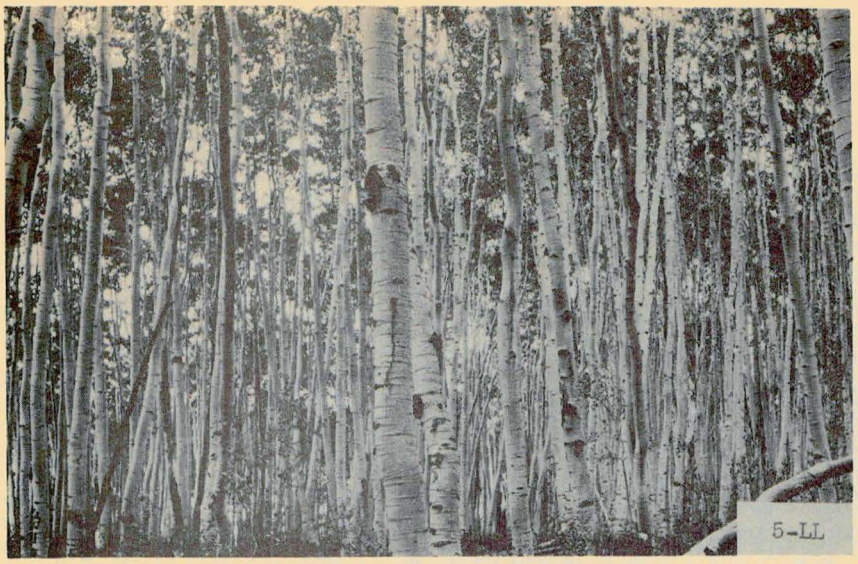
Location: Steep, exposed slopes - - - - - - - - - - - - - - - - HM
Location: On protected or heavily grazed exposed slopes - - - MM
Location: Flats - ML°

Note: Where reproduction is dense or continuous, treat as reproduction only as given under 4b. If thinned, treat as under 4c.

ASPEN

Pure Stands

Type Symbol - 5



Forest Type: Pure aspen stands.

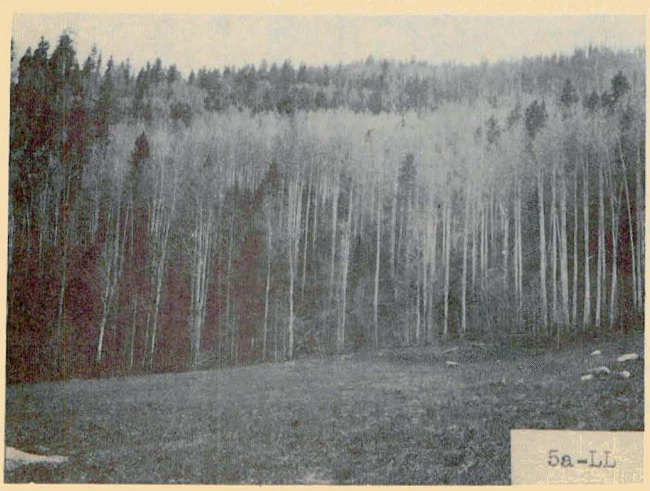
Fuels: Wherever aspen forms a complete stand with light annual weed growth underneath, it is a characteristic low hazard type with considerable resistance to fire even in spring and fall due to low inflammability of its leaves.

Location: Any - LL°

Fuels: Ponderosa pine reproduction with 10-20% aspen. Grass and weeds.

Location: Steep north or moderate south and west slopes - - - - - - - - - - MM

Fuels: Same but with lodgepole instead of ponderosa - - - - - - - - - - - LM



ASPEN-CONIFER

Mixed Stands

Type Symbol - 5a

Fuels: Same but with ponderosa

Location: Gentle, protected - - ML

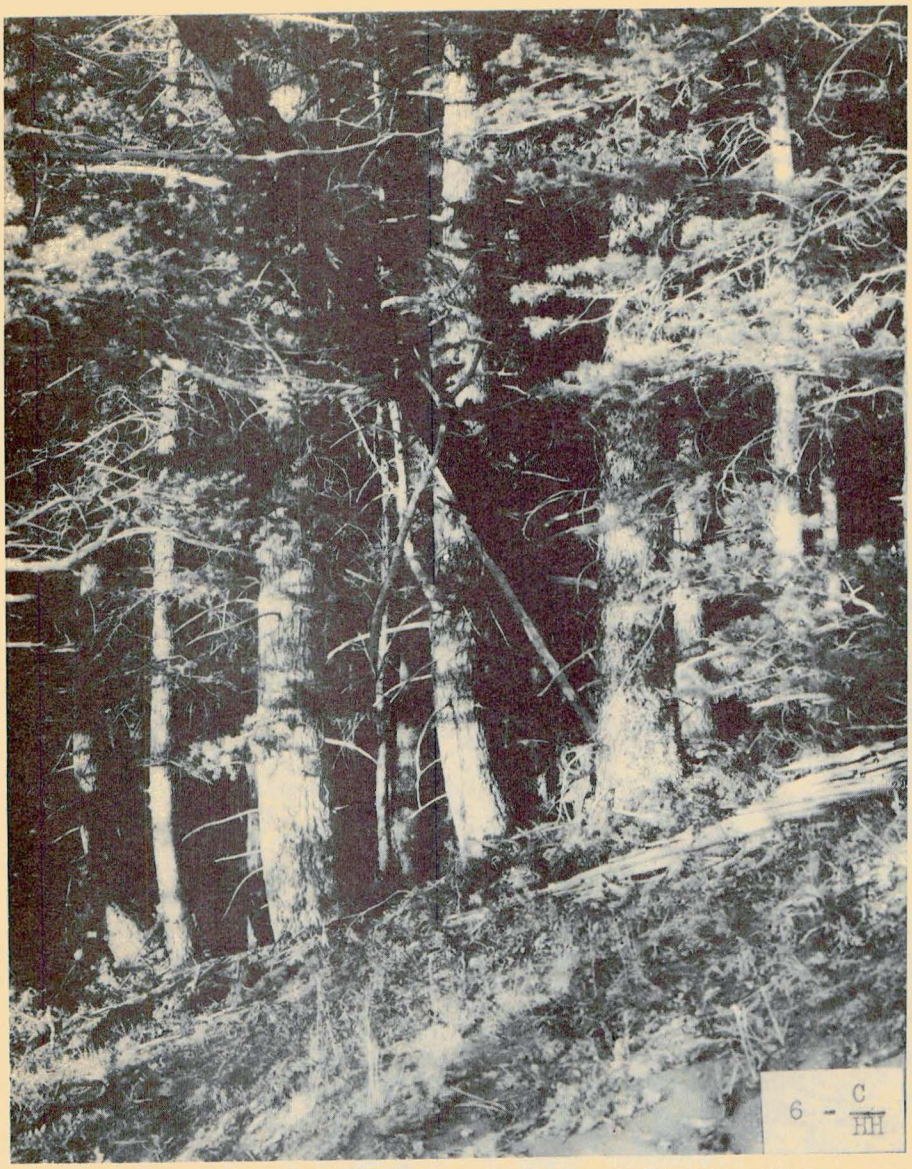
Fuels: Same but with lodgepole or spruce

Location: Gentle, protected - - LL

Fuels: Over 20% aspen

Location: Any - - - LL°°

Note: If dense and continuous grass and weed cover is exposed, rate by reference to type 3.



Forest Type: Douglas fir, mature, or older pole stands.

Fuel: Dense stagnated stands with heavy understory of suppressed and dying trees, limbs from ground up, almost continuous debris, tree moss in crowns.

Location: Steep, exposed slopes or on more gentle slopes with frequent openings and small parks of flashy fuels - - - $\frac{C}{HH}$

DOUGLAS FIR

Mature

Type Symbol - 6

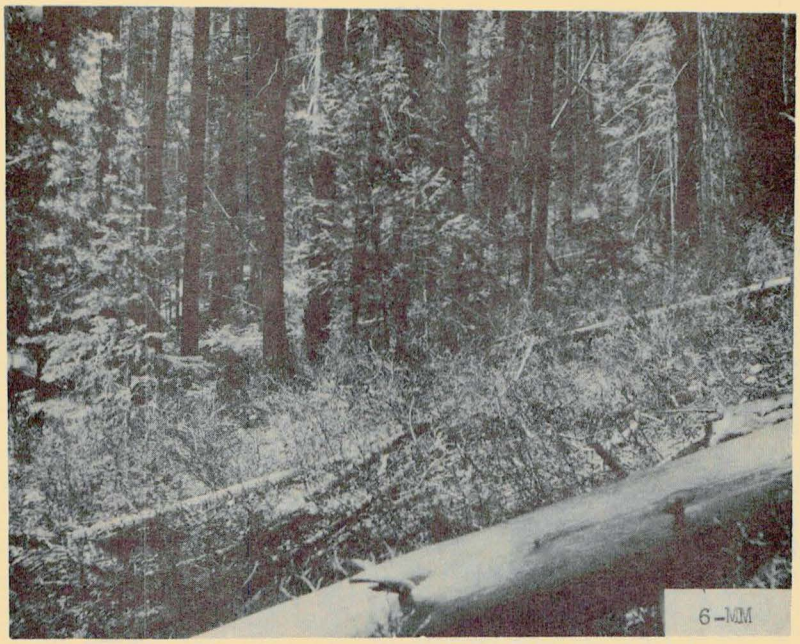
Fuel: Stand badly damaged by bud worm. Branches come down to ground, more than 20% of lateral branches dead, heavy branchwood litter; dense grass and weed cover in openings. Considerable tree moss in crowns.
Location: All slopes and exposures unless broken by barriers - - $\frac{C°}{HH}$

Fuel: Dense green stands with suppressed trees, less continuous understory material well shaded; no tree moss but marginal parks and openings carrying flashy fuels.
Location: Moderate or protected slopes - - - - - - - - - - - - - MH

DOUGLAS FIR

Mature

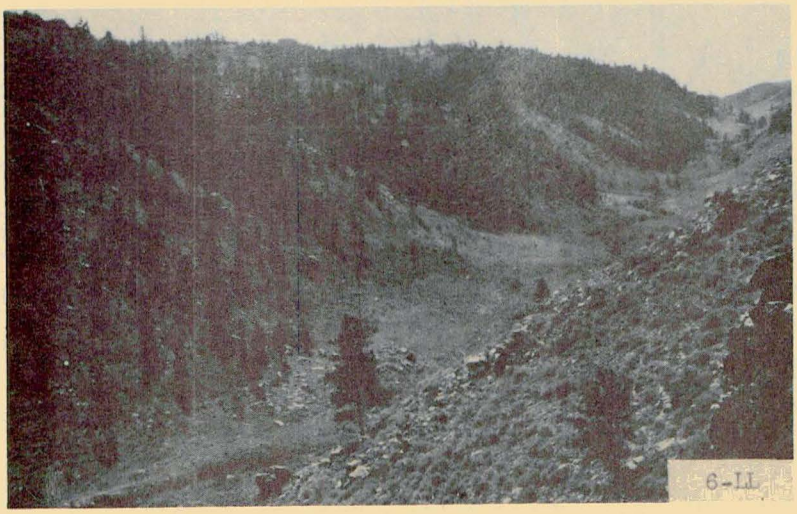
Type Symbol - 6



Forest Type: Mature Douglas fir or older pole stand.

Fuel: More open stands. Considerable heavy material on the ground, snags present, openings with grass, brush and weeds. (If large amount of reproduction is present, "C" factor may be appropriate).
Location: Flats and protected slopes - - - - - - - - - - - MM°

Fuel: Open stands merging into grass and sage brush parks of low density cover. Little reproduction.
Location: Steep, exposed slopes - - - - - - - - - - - - - ML
Location: Flat or gentle, protected slopes - - - - - - - - LL°°



DOUGLAS FIR

Cut-over

Type Symbol - 6a

6a-MH

Fuel: Continuous slash exposed to sun, ragged canopy, considerable heavy material on the ground.
Location: Steep, exposed slopes - - - - - - - - - - - - - - - - HH

Fuel: Same but shaded - MH°

Fuel: Heavy but broken slash, not continuous

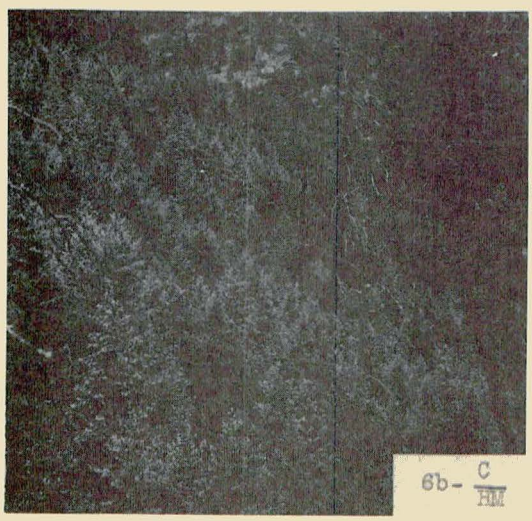
Location: Steep, exposed slopes - - - - - - - - - - - - - - - .HM

Fuel: Light cutting or thinning, heavy material removed, thin slash in contact with ground, considerable shade.
Location: Gentle, protected slopes or flats - - - - - - - - - ML

DOUGLAS FIR
Reproduction
Type Symbol - 6b

Fuel: Dense reproduction, with or without grassy openings. See illustration for spruce (2b).

Location: Steep, exposed slopes - - - - - - $\frac{C}{HM}$ °°



6b- $\frac{C}{HM}$

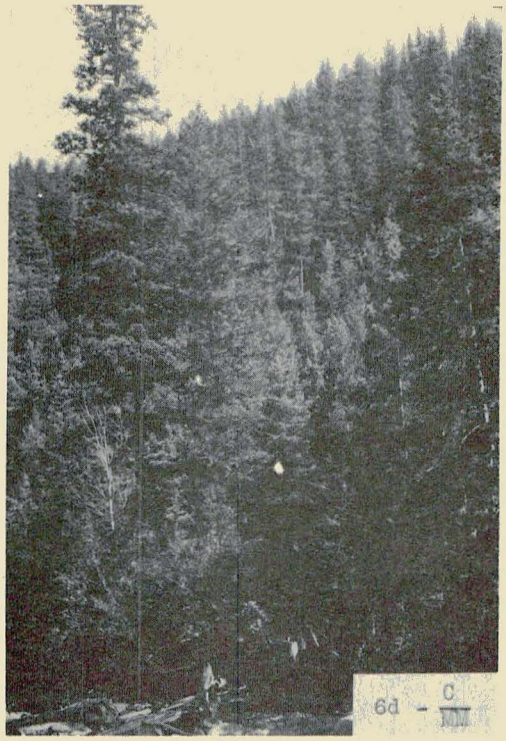
Location: Flats, gentle protected slope - - $\frac{C}{MM}$

Fuel: Scattered reproduction, overhead canopy.
Location: Flats or protected slopes - - - - - MM

DOUGLAS FIR

Uneven-aged

Type Symbol - 6d



Forest type: Douglas fir, uneven-aged stands.
(usually mixed conifer type)

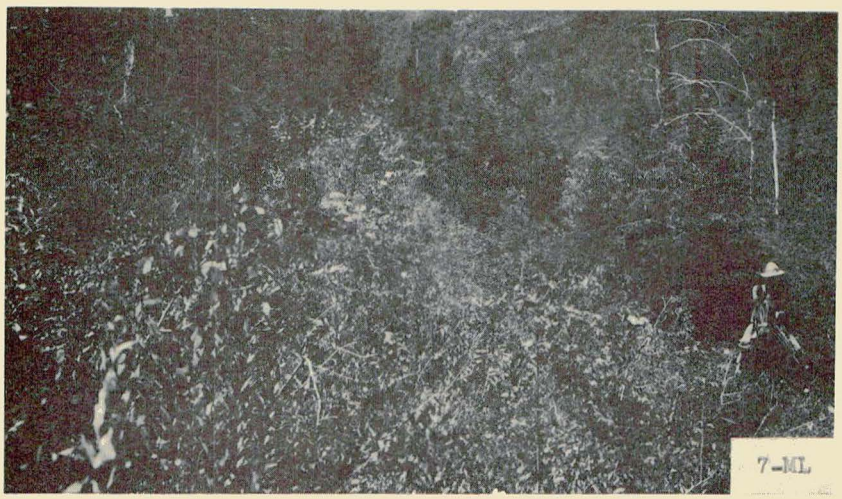
Fuels: Heavy understory of Douglas fir, spruce and alpine fir. Much dead material on ground, many snags and much dying crown material.
Location: Steep, exposed slopes - - - - - - - - - - - - - - - C/HM .
Location: Gentle, protected slopes, flats - - - - - - - - - C/MM

Fuels: Not continuous canopy or not continuous understory, thin grass little down or dead
Location: Gentle, protected slopes - - - - - - - - - - - - ML or LL

BRUSH

Hardwood
other than oak

Type Symbol - 7



Forest type: Mixed hardwood brush other than oak.

Fuels: Dense, continuous stand of brush, little oak present, many breaks in low cover, little dead material under bushes.
Location: Steep, exposed slopes - - - - - - - - - - - - - ML°
Location: Flats, gentle protected slopes - - - - - - - - - LL

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BRUSH

Oak

Type Symbol - 7a

Forest Type: Oak brush or mixed hardwood brush with considerable oak present.

Fuels: Dense and continuous, considerable dead material, especially leaves on ground.
Location: Steep, exposed slopes - - - - - - - - - - - - - HM
Location: Gentle, protected slopes or flats - - - - - - - MM

Fuel: Same, but broken into clumps and patches with intervening grass openings, heavily grazed.
Location: Gentle, protected slopes - - - - - - - - - - - LL

Type Symbol - 8

Forest type: Sagebrush. Rating will depend largely on amount and character of intermingled vegetation and degree of grazing.

Fuel: Dense sage, waist high; heavy stand of grass intermingled, ungrazed.
Location: Steep, unprotected slopes - - - - - - - - - - - - - HM
Location: Flats, or gentle protected slopes - - - - - - - - - ML°

Fuel: Same but less dense sage, more grassy openings
Location: Steep or exposed - - - - - - - - - - - - - - - - - -HL

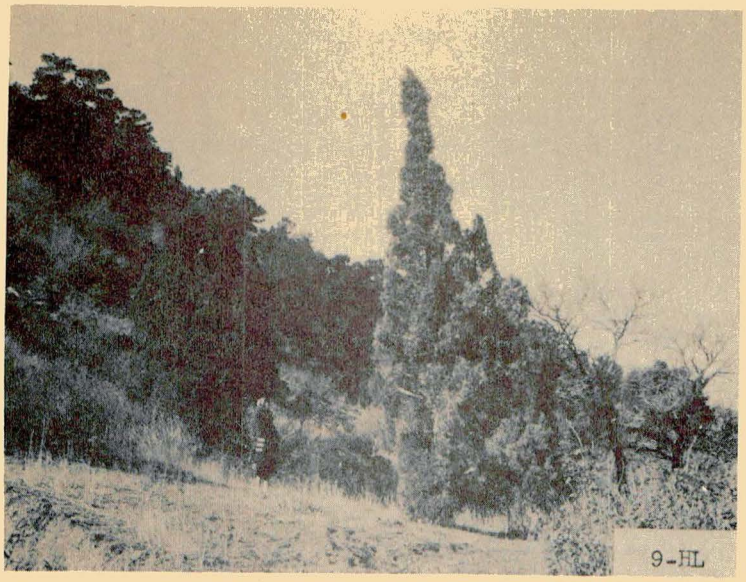
Fuel: Patchy cover heavily grazed

Location: Any - LL°°

PINON-JUNIPER

All stands

Type Symbol - 9



9-HL

Forest type: Pinon-juniper.

Fuels: Scattered trees, grassy openings ungrazed; less than 20% of ground bare of vegetation.
Location: Steep, exposed slopes - - - - - - - - - - - - HL°

Fuels: Same but more than 20% bare ground.
Location: Flats or gentle slopes - - - - - - - - - - - ML

Fuels: Same but heavily grazed, considerable exposed bare soil.
Location: Any - LL°°

9-LL

LIMBER-BRISTLECONE PINE

Type Symbol - 10

Forest type: Mixed conifer with limber, white bark or bristle-cone pine.

Fuel: Usually very sparse grass, annuals, etc., and frequent rock barriers, duff or litter patchy. Trees scattered, seldom in dense stand, frequently near timber line. Can often be classed as sub-alpine.

Typical rating - LL

Higher ratings depend on amount and continuity of dry fuels and the degree of exposure. Bristlecone has potentialities for high fuel hazard, limber and white bark only where bug-killed or fire damaged.

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WHITE FIR

Type Symbol - 11

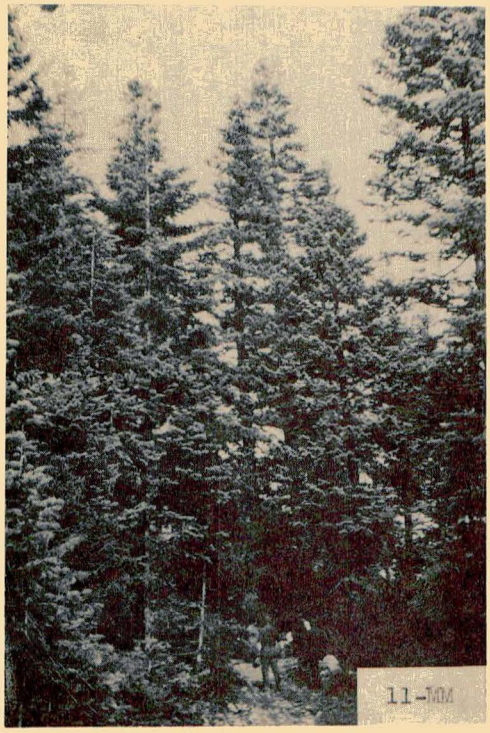
Forest type: White fir, usually mixed with spruce, Douglas fir, etc., at high elevations or on shaded slopes.

Fuel: Heavy understory of stagnant and dead trees with Douglas fir. Tree moss in crowns, almost continuous debris.
Location: Steep and exposed - - - - - - - - C MH

Fuels: No tree moss, little down material.
Location: Steep exposed - MM°
Location: Moist flats and slopes - - - - - - - - - LM

Fuels: Clean floor, little down or dead, reproduction scattered.
Location: Any - - - - - - LL

Note: For white fir reproduction refer to spruce and Douglas fir.



12-LL

SUB-ALPINE

Type Symbol - 12

Forest type: sub-alpine

Fuel: Ragged stands of fir, spruce, etc. Limbs down to ground and much dead fuel in decadent clumps. Typically in thin stands or isolated patches separated by bare rock, nearly bare soil or wet meadow.

Location: Any, unless unbroken on steep slopes - - - - LL°

13-OL

ALPINE

Type Symbol - 13

Forest type: Alpine

Fuel: Fuels too widely separated to carry fire under most conditions.

Location: any - - - OL°°

NO FIRE HAZARD

Type Symbol - 13a

Forest type: Barren

Fuels: Areas in which rock predominates and non-inflammable cover is found at high elevations.

Location: Any - 00

MIXED HARDWOODS

Type Symbol - 14

Forest type: Mixed hardwood (not aspen)

Fuel: Seasonal ratings for April and May or at times in fall, where sufficient hardwood species other than aspen occur to form a litter of curled leaves on the ground - 25% of stand or more.
Where there is dense oak brush - - - - - - - - - - - - HM
Birch, ash, elm, etc. and clean forest floor - - - - HL

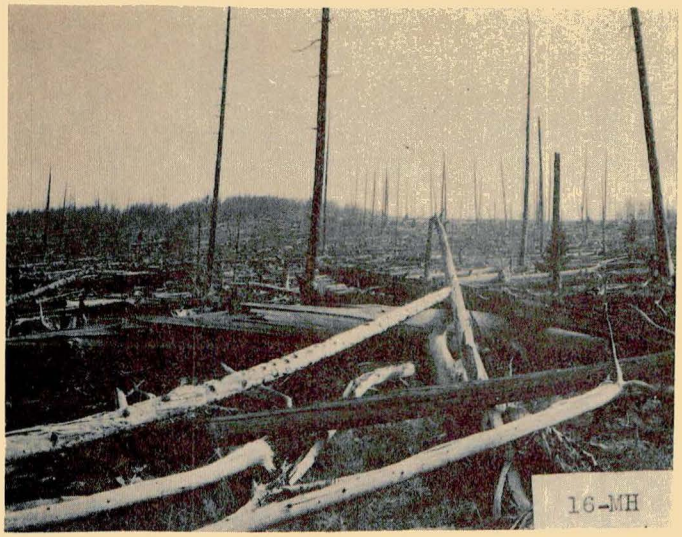
CYCLONE AREAS

Type Symbol - 15

Forest type: Cyclone area.

Ground Cover: Base on specifications for cut-over in timber type involved, making allowance in resistance to control for extra amount of saw and axe work to be accomplished.

BURNS



Type Symbol - 16

Forest type: Burns. (Only recent burns or areas in which there is not enough remaining timber or reproduction to fit other classifications should be rated under this captio: The symbol of the original stand should be added for information.

Fuels: Heavy windthrow from burn in mature stand, considerable branch wood and other fine fuel or dense grass coming up through logs. Some snags present.
Location: All steep slopes of 30% or more or exposed slopes down to 10% - HH

Fuels: Same, but with much of fine material gone.
Location: Flats and gentle slopes - - - - - - - - - - - - - - - - MH°

Fuel: Same but with abundant light fuels and grass but less heavy fuels and frequent breaks - - - - - - - - - - - - - - HM

Fuels: Same but with little light fuel or grass - - - - - MM or LM

Fuel: Complete burn, annuals but little or no grass, no debris.
Location: Any - LL°°

F
Plans
Presuppression
Fuel Types

Denver, Colorado.
January 28, 1938.

INSTRUCTIONS FOR FUEL TYPE MAPPING
ROCKY MOUNTAIN REGION

The following instructions have been developed for general use throughout the Region, but may be further supplemented as the need occurs for additional fuel type descriptions or for better illustration by key photograph of typical forest fuel combinations. They are designed both to guide the judgment of the fuel type mapper in the field and to provide a common basis for discrimination on the part of Forest and Regional Office personnel in setting up fire control plans and in determining correct Regional policies.

To insure uniformity in these fuel type ratings with the similar work being done in adjoining Regions, the following general instructions apply:

Basis for Classification

Two factors will be used as the primary basis for classification. The first is the probable rate of spread of fire in the fuel being considered, the second is the relative difficulty of control or "resistance to control" of fire represented by that fuel in place. The first can be measured and defined as the rate at which a fire will increase its perimeter in a definite period of time from its start; the second as the relative amount of work in man hours required per unit of this perimeter to control the fire. Both can be converted to a common basis, and their variations expressed in terms of the job to be accomplished. "Rate of spread" is the key to the length of control line in chains that will have to be worked after the fire has spread for a given time; "resistance to control", measures the amount of work needed to produce and hold one chain of this control line. Together, they measure the size and difficulty of the job to be done. Neither can be precisely determined in advance for a single fire, but since both are definite and measurable after it occurs, the results and correctness of the rating work can be tested by current experience and past history. For planning purposes, definite values have been assigned to both. Values used for the rates of spread are 4, 8, 12, and 18 chains of perimeter increase per hour. Values for the degrees of resistance to control are 3.2, 1.6, 0.8, and 0.2 chains of held line per man hour. Both will need some further check throughout the Region before they are finally fixed.